

Response
Serial No. 10/809,809
Attorney Docket No. 042278

REMARKS

Claims 9-19 are pending in the present application. Claims 9-19 are rejected. Claims 9 and 12 are herein amended. Withdrawn claims 1 and 5 are herein amended. Claim 20 is cancelled.

Specification Objection

The title of the invention was objected to as not being adequately descriptive. The title of the invention has been amended to “SEMICONDUCTOR DEVICE AND MANUFACTURING METHOD OF THE SAME FOR IMPROVING CARRIER MOBILITY AND REDUCING LEAK CURRENT.” Withdrawal of the objection is requested.

Claim Rejections

Claims 9-19 were rejected under 35 U.S.C. §102(b) as being anticipated by *Kishi* (US Patent 6,133,605). Claim 20 was rejected under 35 U.S.C. 103(a) as being unpatentable over *Kishi*.

Amended claims 9 and 12 recite a manufacturing method of a semiconductor device. The manufacturing method includes steps for forming a gate insulation film. The steps include forming a silicon oxide film over the silicon substrate and introducing nitrogen into the silicon oxide film for displacing silicon atoms on a surface of the silicon substrate towards the gate insulation film side. The amended claims recite the silicon oxide film having a thickness of 1.5 nm or less.

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Kishi discloses a method of manufacturing a semiconductor nonvolatile memory transistor. The method includes forming a tunnel insulator film by forming a silicon dioxide film over the surface of a semiconductor substrate. The silicon dioxide film is nitrided in an ammonia atmosphere at 950 °C to form a silicon nitrided oxide film. Then a silicon nitride film is formed over the tunnel insulator film by a CVD process. A top oxide film is formed on top of the silicon nitride film. A memory gate electrode is formed over the top oxide film. The Examiner acknowledges that *Kishi* does not disclose that the silicon oxide film is 1.5 nm or less.

Applicants respectfully submit that it would not have been obvious to one of ordinary skill in the art to use a silicon oxide film having a thickness of 1.5 nm or less from the teachings of *Kishi*. The use of a silicon oxide film of 1.5 nm or less provides unexpected results. When the thickness of the silicon oxide film is 1.5 nm or less, the subsequent introduction of nitrogen into the silicon oxide film can cause disorder in the film. The disorder displaces silicon atoms on a surface of the silicon substrate toward the silicon oxide film (gate insulation film) due to interface strain. Accordingly, the thickness of 1.5 nm or less is nonobvious.

On the other hand, in *Kishi*, the thickness of the silicon oxide film is set to 2.2 nm. When the silicon oxide film has a thickness of 2.2 nm, a subsequent heat treatment in an ammonia atmosphere cannot cause enough disorder in the silicon oxide film to generate an intended interface strain. The silicon atoms cannot be displaced as intended, and therefore, *Kishi* does not disclose the same effect as in the present invention. In addition, since the displacement of the silicon atoms cannot be controlled in *Kishi*, there is a possibility that problems will arise.

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Accordingly, withdrawal of the § 102 and § 103 rejections of claims 9-19 is hereby solicited.

In view of the aforementioned amendments and accompanying remarks, Applicants submit that the claims, as herein amended, are in condition for allowance. Applicants request such action at an early date.

If the Examiner believes that this application is not now in condition for allowance, the Examiner is requested to contact Applicants' undersigned attorney to arrange for an interview to expedite the disposition of this case.

If this paper is not timely filed, Applicants respectfully petition for an appropriate extension of time. The fees for such an extension or any other fees that may be due with respect to this paper may be charged to Deposit Account No. 50-2866.

Respectfully submitted,

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